Worksheet 4 Subroutines Answers

Task 1

1. A primary school teacher requires a program that will allow pupils to practise their multiplication tables (times tables). The program must allow them to choose the table they want displayed and the start and end numbers to multiply by.

   For example, if the pupil enters 5, 4, 12 the program will display

   5 x 4 = 20
   5 x 5 = 25
   …
   …
   5 x 12 = 60

   The program will then print a message followed by the table selected.

   Create a pseudocode solution for this using a subroutine called **multiples()** which takes **table**, **startnum**, **endnum** and **pupilName** as parameters. The subroutine will output the message and multiplication table. The main program will prompt the user to enter the values and will then pass them to the routine.

```
What is your name?
Joe
Enter times table, start number and end number
7
6
9
Hi, Joe ... here is your times table
7  x  6  =  42
7  x  7  =  49
7  x  8  =  56
7  x  9  =  63
>>>
```

```
procedure multiples(f1,f2start,f2end,name)
    print("Hi ",name, " here is your times table")
    for index = f2start to f2end
        print(f1, " x ", index, " = ", f1 * index)
    next index
endprocedure

#main program
name = input("What is your name? ")
table = input("Enter times table, start number and end number ")
startnum = input()
endnum = input()
multiples(table,startnum,endnum,pupilName)
```

See Python and VB programs W4a Q1 times table

Task 2

2. It is possible to return more than one value from a function. Consider the following Python program:

```
# pass multiple results back from a function
def calc(a,b):
    constantVal = 2
    x = constantVal *(a + b)
    y = a - b
    z = a * b
    return x, y, z

#main program
add, subtract, multiply = calc(5,3)
print (add, subtract, multiply)
```

(a) Name a **local variable** in the subroutine constantVal

(b) What is printed by the statement in the final line of the program? 16 2 15

See Python/VB programs W4 Q2 return multiple values

3. It is often necessary to verify information upon data input. One method of doing this is double entry.

Write pseudocode for a subroutine called **getPword()** that takes one parameter, called **attempt**, which can have a value of 1 or 2. The subroutine should prompt the user to enter a password if attempt = 1, or prompt the user to re-enter a password if attempt = 2, and then return the password.

The subroutine should also check that the length of the password is a valid length between 6 to 8 characters. The main program will verify that the two passwords are the same, and re-prompt for entry if they are not. If both passwords are the same, a message is displayed, informing the user that the password change has been successful.

The output below demonstrates how the program will work.

```
enter password:
abc
Error.  Password must be 6 to 8 characters long
enter password:
123456789
Error.  Password must be 6 to 8 characters long
enter password:
xxxxxx
enter password again:
yyyyyy
Error - passwords do not match
enter password:
qwerty
enter password again:
qwerty
Password change successful
```

```
procedure getPword(attempt)
    pword =   ""
    while len(pword) < 5 OR len(pword) > 8
    if attempt == 1 then
        pword = input("Enter password")
    else
        pword = input("Enter password again")
    endif
    if len(pword) < 5 OR len(pword) > 8 then
        print("Error.  Password must be 6 to 8 characters long")

    endwhile
    return pword
endprocedure
#main program
pword1 = getPword(1)
pword2 =getPword(2)
while pword1 != pword2
    print ("Error passwords do not match")
    pword1 = getPword(1)
    pword2 = getPword(2)
endwhile
print ("Password change successful")
```

See Python/VB programs W4 Q3 Password

4. A company runs a private car park near an airport. The car park has 10 rows numbered 1-10 and each row has spaces (referred to as columns) numbered 1-6 for 6 cars. Customers leave their cars with keys at the car park office, and a driver parks it in a free space.

   The space is referenced by its grid coordinates row and column. E.g. a car parked in the 3rd row, 5th space would have the grid reference [3,5].

The driver enters the car registration into the computer. A car with registration AVH 61 HU parked at grid reference [3,5] would assign "AVH 61 HU" to **park[3,5]**. Empty spaces are denoted, for example, by **park[3,5] = "empty"**

Write pseudocode for a program which displays a menu with 5 options, and for the first four options, calls the relevant subroutine.

Option 1: Set all spaces in the car park to "empty"

Option 2: Park a car. This option asks the user to enter the registration number of a car and the grid reference (row and column number) where it has been parked. The program checks that this is an empty space, and if it is, puts the registration number in the appropriate element of the array. If it is not, it asks the user to enter the grid reference.

Option 3: Remove a car. This option asks the user to enter the registration number, searches the grid for the number and then resets it to "empty".

Option 4: Display the car park grid

Option 5: Quit

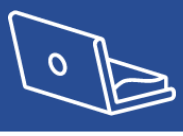
Pseudocode for the main program is given below. This initialises the car park grid to "empty" and then repeatedly displays the menu of options and performs the required function until the user selects "Quit".

Write subroutines for options 2-5. (Assume array indices start at 0)

Note that the way the 2-D array is initialised will vary in different programming languages – the pseudocode does not reflect this. Program solutions in Python and VB are provided.

In Python, for example, the array needs to be initialised before it is passed as a parameter to the subroutines.

```
// main program
initialise car park grid to "empty"
#display menu of options
print("1. Reset all spaces in the car park to 'empty'")
print("2. Park a car")
print("3. Remove a car")
print("4. Display the car park grid")
print("5. Quit\n")
option = input("Enter your choice: ")
// accept choice
while option != "5"
    if option == "1"
        emptyCarPark(carPark)
    else if option == "2"
        parkACar(carPark)
    else if option == "3"
        removeACar(carPark)
    else if option == "4"
        displayCarParkGrid(carPark)
    else
        option = input ("Invalid choice - please re-enter: ")
   endif
    print("1. Reset all spaces in the car park to 'empty'")
    print("2. Park a car")
```




```
    print("3. Remove a car")
    print("4. Display the car park grid")
    print("5. Quit\n")
    option = input("Enter your choice: ")
endwhile
print("Goodbye")

procedure emptyCarPark(carpark)
   // populate car park 2-d array with “empty” in each grid
   reference
   for row = 0 to 9
      for column = 0 to 5
         carPark[row][col] = "empty"
      next column
   next row
   print("car park is now empty")
endprocedure

procedure parkACar(carpark)
   prompt for and enter car registration
   prompt for and enter row and column where car is parked
   emptySpace = False
   while emptySpace = False
      while row < 1 OR row > 10
         row = input("Row must be between 1 and 10 - please re-
   enter: ")
      endwhile
       row = row - 1
       rowValid = True
       while column < 1 or column > 6
           column = input("Column must be between 1 and 6 - please
   re-             enter: ")
      endwhile
      column = column - 1
      columnValid = True
      if rowValid AND columnValid AND (carPark[row][column] ==
   "empty")  then
           emptySpace = True
       else
           rowValid = False
           columnValid = False
           row = 100
           column = 100
           print("That space is taken”)
      endif
   endwhile
   carPark[row][column] = regNo
endprocedure

procedure RemoveACar(carpark)
   regno = input("Enter the car registration: ")
    carFound = False
// search for car
    for row = 0 TO 9
        for column = 0 TO 5
```

```
            symbol = carPark[row][column]
            if symbol == regNo
                carPark[row][column] = "empty"
                carFound = True
         endif
      next column
   next row
   if carFound == False
      print("Car not found")
endprocedure

procedure displayCarParkGrid(carpark)
   for row = 0 to 9
      for column = 0 to 5
         symbol = carPark[row][column]
         write (symbol,' ',)       // print without moving to new
   line
      next  column
      writeline                  // move to new line
   next row
endprocedure
```

See Python/VB programs W4 Q4 car park using subroutines